REMARKS

1. Objections to the Specification

The Examiner has pointed out numerous typographical errors in the specification. These have been corrected as required.

2. Objections to the Drawings

The Examiner has indicated that the specification contains reference signs 32, 74 and 214, but these elements are not depicted in the Figures. The specification has been corrected to remove reference signs 32 and 74, and Figure 3 has been amended to show reference sign 214.

The Examiner has also indicated that Figure 1 contains reference signs 118, 135 and 136, but these reference signs are not described in the specification. Reference sign 118 is listed on page 5, line 14. Figure 1 has been amended so that the reference signs in the Figure and specification are consistent.

3. Status of Claims

Claims 3, 5, 7 and 15 have been amended. Claims 1, 2, 4, and 9 have been cancelled. Claims 10-12 are withdrawn from consideration. Claims 26-40 have been added. As a result of this amendment, claims 3, 5-8 and 13-40 are pending.

Applicant notes with appreciation the allowance of claim 23.

The Examiner has indicated that claims 3, 15, and 16, which depend from a rejected base claim, would be allowable if rewritten to include all the limitations of the base claim and all intervening claims.

Claim 3 has been amended to include the limitations of claims 1 and 2. Accordingly, Applicant submits that claim 3 is now in condition for allowance.

Claim 15 has been amended to include the limitations of claim 14. Accordingly, Applicant submits that claim 15 is now in condition for allowance. Since claim 16 depends directly from claim 15, claim 16 is also in condition for allowance.

4. Anticipation Rejection

Claims 1, 2, 4 and 9 were rejected under 35 U.S.C. §102(e) as anticipated by Perlov et al. (USPN 5,964,563). Claims 1, 2, 4, and 9 have been cancelled.

5. Obviousness Rejections based on Lee

Claims 5, 6, 13, 14, 17 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Perlov (USPN 5,964,563) in view of Lee (USPN 5,851,136).

Applicant respectfully traverses the Examiner's 103(a) rejections.

5A. Claim 5, 6, 13 and 14

Claim 5 has been amended to include all of the limitations of the previous claims 1 and 5. In addition, claim 5 has been amended to recites in pertinent part, a carrier head "wherein at least one of the annular flaps includes a notch positioned and configured to reduce compressions in the main portion caused by downward load transmitted through the annular flap of the flexible membrane." Support for the amendment can be found on page 7, lines 12-30 of Applicant's specification.

The Examiner contends that all of the limitations of claim 5, with the exception of the annular flaps including a notch, are disclosed by Perlov. The Examiner contends that the annular flap including the notch is disclosed by Lee and that it would have been obvious to one having ordinary skill in the art to combine the "notch" of Lee with the carrier head of Perlov resulting in the instant invention of claim 5. Applicant must respectfully disagree.

The Examiner points to Figure 10 and col. 10, line 62 to col. 11, line 27 in Lee to support the contention that Lee discloses an annular flap containing a notch. This passage refers to a steel platen containing a "living hinge or notch" 277a at the junction between the wall 276 and the face of the platen 277. (Lee, col. 11, lines 3-26). Even if the steel platen wall of Lee can be seen as equivalent to the flexible annular flap, the living hinge or notch does not provide the same function as the notch recited in claim 5.

The function of the living hinge (depicted as 277a in Figure 10) is to allow the face of the platen 277 to flex allowing the platen to take on a convex or concave shape. Lee states, "[w]all 276 and platen 277 form a 'living hinge' or notch 277a which functions to allow the face of platen 277 to minimize geometric distortions at the periphery and closely assume a substantially spherical or continuous arc shape." (Lee, col. 11, lines 16-20). The operation of the flexing

platen is clearly depicted in Figure 15a, where it takes on a convex shape and figure 15b where it takes on a concave shape. Thus, it is clear that the "distortions at the periphery" mentioned by Lee are distortions away from the spherical or continuous arc shape.

In contrast, in the flexible membrane described by claim 5, the notch is configured to reduce compressions in the main portion caused by downward load transmitted through the annular flap of the flexible membrane. It is clear that the living hinge of Lee does not have this effect. Specifically, Lee's thick wall 276 will transmit downward load from the drive shaft 204 and the top plate 274 directly onto the main portion and thus onto the edge of the substrate.

Since Lee fails to teach a notch that reduce compressions in the main portion caused by downward load transmitted through the annular flap of the flexible membrane, the combination of Perlov and Lee cannot render claim 5 obvious. Since claim 6 depends directly from claim 5, claim 6 is allowable for at least the reasons claim 5 is allowable.

Claim 13 stands similarly rejected. Claim 13 recites in pertinent part, "... at least one of the annular portions including a notch positioned and configured to reduce compressions in the main portion caused by downward load transmitted through the annular portion of the flexible membrane." Since there is no motivation to combine the notch of Lee with the elements of Perlov, Applicant submits that claim 13 is allowable over Perlov and Lee. Since claim 14 depends directly from claim 13, claim 14 is allowable for at least the reasons claim 13 is allowable.

5B. Claims 17 and 24

Claim 17 recites, in pertinent part, a carrier head having "an outer annular portion extending from an edge of the main portion and secured to the base assembly, and an inner annular portion extending from the main portion and secured to the base assembly, ... the inner annular portion including a notch." Claim 24 similarly recites, in pertinent part, "the inner annular portion including a notch."

The combination of Perlov and Lee would not result in the invention of claims 17 and 24.

Perlov shows the living hinge or notch 277 located at the outermost section of the platen, adjacent the retaining ring. Thus, if Lee's notch were to be combined with Perlov's membrane, the notch would be located in the outer annular portion (at the edge of the main portion), not in the inner annular portion, as recited in claims 17 and 24.

In addition, Applicants submit that the Examiner has not identified a proper motivation to combine the living hinge of Lee with the elements of Perlov, and specifically, no motivation to place a notch in the inner annular portion rather than the outer annular portion.

The Examiner contends that it would have been obvious to one of ordinary skill in the art to incorporate the notch of Lee with the elements of Perlov "in order to minimize distortion of the flexible membrane." However, as discussed above, the living hinge of Lee actually serves to permit the face of the platen to take on a spherical shape, rather than preventing compressions. In Perlov, the length of the inner annular flap would constrain the outward expansion of the flexible membrane and prevent it from assuming a spherical shape. Since a notch would not change the length of Perlov's inner annular flaps, the addition of the notch would not provide or improve the capacity for Perlov's membrane to assume a spherical shape. Since the benefit of Lee's notch is not applicable to Perlov, the Examiner has not shown a motivation to make the combination.

Applicant submits that claims 17 and 24 are allowable over the combination of Perlov and Zuniga.

5C. New claims

Claims 26-31 have been added. These claims are similar to claims 5, 6, 13, 14, 17 and 24, but are directed toward embodiments where the notch is adapted to allow the at least one of the annular flaps to flex when the pressure is unequal in adjacent pressurizeable chambers. Support for the claim may be found in the specification. For example, the specification states, in pertinent part, "...the notch 200 makes the flap 150a more flexible at the connection 202. This reduces compression in the main portion 142 when the flap bends due to unequal pressure in chambers 160 and 162, thereby improving polishing uniformity." (Page 7, lines 18-21).

It is submitted that these claims are clearly allowable over the combination of Lee and Perlov. Firstly, the annular portions of the membrane are flexible. Secondly, the notch of claim 26 is adapted to allow the at least one of the annular flaps to flex when the pressure is unequal in adjacent pressurizable chambers. Consequently, this configuration may reduce distortion of the flexible membrane by allowing increased flexibility of the annular flaps. In other words, the notches in annular flaps allow the force resulting from unequal pressure in adjacent chambers to

deform the annular flap so that less pressure may be transmitted though the connection of the annular flap with the flexible membrane.

In contrast, in Lee's system the wall 276 is rigid (as shown in Figure 15a, the wall 276 does not bow outwardly the pressure inside chamber 278 increases). Moreover, the living hinge of Lee is designed to allow the substrate-mounting surface to flex and assume a spherical configuration rather than increase the flexiblity of the wall. Since the function of the living hinge of Lee is so clearly different from the function of the notch of claims 26-31, it submitted that these claims are allowable over the combination of Lee and Perlov.

6. Obviousness rejections using the Zuniga reference

Claims 7, 8, 18-22 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Perlov (USPN 5,964,563) in view of Zuniga et al (USPN 6,159,079).

Applicant respectfully traverses the Examiner's 103(a) rejections.

6A. Claims 7 and 8

Claim 7 has been amended to include all of the previous limitations of claims 1 and 7. Claim 7 recites in pertinent part a carrier head, "wherein the at least one annular flaps includes a widened section adjacent a juncture between the at least one annular flap and the main portion." The Examiner contends that these limitations are disclosed by Zuniga. In support of this contention, the Examiner points to element 186 in Figure 2 and column 6, lines 33-56. Element 186 in Figure 2 of Zuniga does not refer to a widened section of the annular flap, as recited in claim 7. Rather, 186 refers to "...a flexible lip portion 186 which extends outwardly from a juncture 184 between inner portion 180 and edge portion 182 to contact a perimeter portion of a substrate loaded in the carrier head." (Zuniga, col. 6, lines 39-42). Since the claimed annular flap is "secured to the base assembly", whereas the lip portion 186 extends outwardly from the junction and is not secured to the base, the lip portion 186 is clearly not a widened section of the annular flap within the meaning of claim 7.

The text in Zuniga cited by the Examiner also refers to a thick junction between the flexible membrane and the annular edge portion: "The juncture 184 is located generally beneath recess 178 in support plate 170 , and is thicker, e.g., about twice as thick, than inner portion 180 or edge portion 182." (Zuniga, col. 6, lines 42-45). However, this thick juncture portion of

Zuniga is included in the central portion 180 of the flexible membrane that provides the substrate mounting surface, and is not part of the perimeter portion 182. In other words, in Zuniga, the central portion of the flexible membrane 180 is widened, not an annular flap. In contrast, claim 7 recites an annular flap including a widened portion.

Since Zuniga does not disclose a carrier head, "wherein the at least one annular flaps includes a widened section adjacent a juncture between the at least one annular flap and the main portion," as clearly recited in claim 7, that claim is allowable over the combination of Zuniga and Perlov. Since claim 8 depends directly from claim 7, that claim is allowable for at least the reasons claim 7 is allowable.

6B. Claims 18-22 and 25

Claim 18 recites, in pertinent part, "...an outer annular portion extending from an edge of the main portion and secured to the base assembly, and an inner annular portion extending from the main portion and secured to the base assembly, ... the inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion." Claim 25 similarly recites, in pertinent part, "... the inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion."

As discussed above, Zuniga does not show an "annular portion including a widened section."

However, even assuming arguendo that Zuniga's lip 186 or juncture 184 provided a widened portion of an annular flap, the combination of Perlov and Zuniga would not result in the invention of claims 18 or 25.

Zuniga shows the lip 186 and juncture 184 located at the edge of the substrate mounting surface, at the peripheral portion 182 of the membrane adjacent the retaining ring. Thus, if Zuniga's lip or juncture were to be combined with Perlov's membrane, the thick portion would be located in the outer annular portion (at the edge of the main portion), not in the inner annular portion, as recited in claims 18 and 25.

In addition, Applicants submit that the Examiner has not identified a proper motivation to combine the lip or juncture of Zuniga with the elements of Perlov, and specifically, no motivation to place the lip or juncture in the inner annular portion rather than the outer annular portion.

The Examiner contends that it would have been obvious to one of ordinary skill in the art to incorporate the widened section of Zuniga with the elements of Perlov "in order to improve chucking of a wafer." However, Zuniga's lip portion 186 could only function at the outer edge of the substrate mounting section. Similarly, Zuniga's juncture 184 does not improves chucking on its own, but rather due to its interaction with the lip portion (see column 7, lines 47-51). Thus, the stated motivation to improve chucking of a wafer could only be applicable to placement of the widened section at the outer annular portion, not at the inner annular portion.

Applicant submits that claims 18 and 25 are allowable over the combination of Perlov and Zuniga. Since claims 19-22 depend, either directly or indirectly, from claim 18, those claims are allowable for at least the reasons claim 18 is allowable.

6C. New claims

Claim 32 is directed in part toward a carrier head having a base assembly and a flexible membrane having a main portion and an inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion and a section extending generally parallel to the main portion that has a first edge joined to an apex of the widened section and a second edge secured to the base assembly. Support for the claims can be found in the specification. For example, the inner annular portion section extending generally parallel to the main portion that has a first edge joined to an apex of the widened section and a second edge secured to the base assembly is clearly shown in Figure 4A. Applicant submits that Zuniga does not disclose any similar structure in an inner annular portion. Claim 32, therefore, is allowable over any combination of Zuniga and Perlov.

Claims 33-40 are similar to claims 7, 8, 18-22 and 25, but are directed toward embodiments where the function of the widened section is to stiffen the annular flap or the annular portion. Support for these claims can be found in the specification. For example, the specification states, "[t]he wedge-shaped portion 230 generally prevents the membrane flap from bowing into the low-pressure chamber, thereby reducing or eliminating compressions in the main portion 142c that might result from bending of the flap" (page 8, lines 19-22).

In contrast to these new claims, Zuniga contains no suggestion of widening any portion of the flexible membrane in order to stiffen an annular flap or an annular portion.

The widened juncture 184 of Zuniga is intended to stiffen the flexible membrane so when the membrane 180 is flexed, force is transmitted to the flexible lip portion 186. Zuniga states, "[t]he thickness of juncture 184 should be selected to proved sufficient rigidity to ensure that the lip portion pivots upwardly when the inner portion of flexible membrane 118 is urged downwardly." (Zuniga, col. 7, lines 47-51). The operation whereby force is transmitted from the substrate-mounting surface to the flexible lip is depicted in Figure 4B.

Where the Zuniga reference is concerned with stiffening the substrate-mounting surface, the invention as described in claims 33-40 is concerned with stiffening the annular flaps or the annular portion. There is simply no indication anywhere in Zuniga that it would be advantageous to stiffen the annular flap. Indeed, Zuniga's Figure 4B plainly shows that annular flap flexibility is necessary for the operation of that device. Figure 4B shows that the annular flap portion 182 must flex in order for the flexible lip portion 186 to rotate up off the substrate. The fact that the Zuniga carrier head *requires* flexible annular flaps indicates that no one of skill in the art would incorporate a feature from Zuniga in order to stiffen the annular flaps.

Since Zuniga does not teach or suggest stiffening the annular flap or the annular portion, Applicant submits that claims 33-40 are allowable over any combination of Zuniga and Perlov.

Attached is a marked-up version of the changes being made by the current amendment.

Applicant asks that all claims be allowed. Enclosed is a $1064 check, including $954 for excess claim fees and $110 for the Petition for Extension of Time fee. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 2/3/03

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Version with markings to show changes made

In the specification:

The paragraph beginning at page 3, line 17 has been amended as follows:

In another aspect, the invention is directed to a carrier head with a base assembly and a flexible membrane. The flexible membrane has a generally circular main portion, an outer annular portion, and an inner annular portion that includes a notch. The main portion has a lower surface that provides a substrate-mounting surface. The outer annular portion extends from an edge of the main portion and secured to the base assembly. The [the] inner annular portion extends from the main portion and is secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers.

The paragraph beginning at page 4, line 21 has been amended as follows:

The housing 102 can generally be circular in shape and can be connected to the drive shaft [74] to rotate therewith during polishing. A vertical bore 120 may be formed through the housing 102, and five additional passages 122 (only two passages are illustrated) may extend through the housing 102 for pneumatic control of the carrier head. O-rings 124 may be used to form fluid-tight seals between the passages through the housing and passages through the drive shaft.

The paragraph beginning at page 5, line 1 has been amended as follows:

The loading chamber 108 is located between the housing 102 and the base assembly 104 to apply a load, i.e., a downward pressure or weight, to the base assembly 104. The vertical position of the base assembly 104 relative to the polishing pad [32] is also controlled by the loading chamber 108. An inner edge of a generally ring-shaped rolling diaphragm 126 may be clamped to the housing 102 by an inner clamp ring 128. An outer edge of the rolling diaphragm 126 may be clamped to the base assembly 104 by the outer clamp ring 134.

The paragraph beginning at page 5, line 8 has been amended as follows:

The retaining ring 110 may be a generally annular ring secured at the outer edge of the base assembly 104. When fluid is pumped into the loading chamber 108 and the base assembly 104 is pushed downwardly, the retaining ring 110 is also pushed downwardly to apply a load to the polishing pad [32]. A bottom surface 116 of the retaining ring 110 may be substantially flat, or it may have a plurality of channels to facilitate transport of slurry from outside the retaining ring to the substrate. An inner surface 118 of the retaining ring 110 engages the substrate to prevent it from escaping from beneath the carrier head.

The paragraph beginning at page 5, line 24 has been amended as follows:

The volume between the base assembly 104 and the internal membrane 150 that is sealed by the first flap 150 provides a first circular pressurizable chamber 160. The volume between the base assembly 104 and the internal membrane 150 that is sealed between the first flap 150 and the second flap 152 provides a second pressurizable annular chamber 162 surrounding the first chamber 160. Similarly, the volume between the second flap 152 and the third flap 154 provides a third pressurizable chamber 164, the volume between the third flap 154 and the fourth flap 156 provides a fourth pressurizable chamber 166, and the volume between the fourth flap 156 and the fifth flap 158 provides a fifth pressurizable chamber 168. As illustrated, the outermost chamber 168 is the narrowest chamber. In fact, the chambers 162, 164, 166 and 168 [152, 154, 156 and 158] can be configured to be successively narrower.

The paragraph beginning at page 8, line 24 has been amended as follows:

The two outer chambers 166c and 168c can be used to control the pressure distribution on the outer perimeter of the substrate. If the pressure P_1 in the outermost chamber 168c is greater than the pressure P_2 in the second chamber 166c, the outer portion 224 of the flexible membrane 140c is driven downwardly, causing the lower vertex 226 the outer portion 224 to apply a load to the outer edge of the substrate. On the other hand, as shown in Figure 4B, if the pressure P_1 in the outermost chamber 168c is less than the pressure P_2 in the second chamber 166c, the outer portion 224 pivots so that the lower vertex 226 is drawn upwardly. This causes the outer edge of the main portion 142c to be drawn upwardly and away from the perimeter portion of the

substrate, thereby reducing or eliminating the pressure applied on this perimeter portion. By varying the relative pressures in the chambers 166c and 168c, the radial width of the section of the membrane pulled away from the substrate can also be varied. Thus, both the outer diameter of the contact area between the membrane and the substrate, and the pressure applied in that contact area, can be controlled in this implementation of the carrier head.

In the claims:

Claims 1, 2, 4 and 9 have been cancelled.

Claim 3, 5, 7, 13 and 15 have been amended as follows:

3. (Amended) A carrier head, comprising:

a housing to be secured to a drive shaft;

a base assembly;

a loading chamber controlling the position of the base assembly relative to the housing; a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular flaps secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers; and

a retaining ring joined to the base assembly;

[The carrier head of claim 2,]wherein the carrier head includes five pressurizable chambers.

5. (Amended) A carrier head, comprising:

a housing to be secured to a drive shaft;

a base assembly;

a loading chamber controlling the position of the base assembly relative to the housing; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric flexible annular flaps secured

to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers;

[The carrier head of claim 1,] wherein at least one of the annular flaps includes a notch positioned and configured to reduce compressions in the main portion caused by downward load transmitted through the annular flap of the flexible membrane.

7. (Amended) A carrier head, comprising:

a housing to be secured to a drive shaft;

a base assembly;

a loading chamber controlling the position of the base assembly relative to the housing; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular flaps secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers;

[The carrier head of claim 1,]wherein at least one of the annular flaps includes a widened section adjacent a juncture between the at least one annular flap and the main portion.

13. (Amended) A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular portions extending from the main portion and secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers, at least one of the annular portions including a notch positioned and configured to reduce compressions in the main portion caused by downward load transmitted through the annular portion of the flexible membrane.

15. (Amended) A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular portions extending from the main portion and secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers, at least one of the annular portions including a notch;

[The carrier head of claim 15,] wherein a first notch of the plurality of notches is formed at a juncture between the at least one annular portion and the main portion and a second notch of the plurality of notches is formed at about a mid-point of the annular portion.

New claims 26-40 have been added:

26. A carrier head, comprising:

a housing to be secured to a drive shaft;

a base assembly;

a loading chamber controlling the position of the base assembly relative to the housing; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of flexible concentric annular flaps secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers;

wherein at least one of the annular flaps includes a notch adapted to allow the at least one of the annular flaps to flex when the pressure is unequal in adjacent pressurizeable chambers.

27. The carrier head of claim 26, wherein the notch is formed at a juncture between the at least one annular flap and the main portion.

28. A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular portions extending from the main portion and secured to the base assembly, the volume between the base assembly

and the flexible membrane forming a plurality of pressurizable chambers, at least one of the annular portions including a notch adapted to allow the at least one of the annular portions to flex when the pressure is unequal in adjacent pressurizeable chambers.

29. The carrier head of claim 28, wherein the notch is formed at a juncture between the at least one annular portion and the main portion.

30. A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface, an outer annular portion extending from an edge of the main portion and secured to the base assembly, and an inner annular portion extending from the main portion and secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers, the inner annular portion including a notch adapted to allow the inner annular portion to flex when the pressure is unequal in adjacent pressurizeable chambers.

31. A flexible membrane for use in a chemical mechanical polishing carrier head, comprising:

a generally circular main portion with a lower surface to provide a substrate-mounting surface;

an outer annular portion extending from an edge of the main portion to be secured to a base assembly of the carrier head; and

an inner annular portion extending from the main portion to be secured to the base assembly, the inner annular portion including a notch adapted to allow the inner annular portion to flex.

32. A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface, an outer annular portion extending from an edge of the main portion and secured to the base assembly, and an inner annular portion extending from the main portion and secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers, the inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion and a section extending generally parallel to the main portion that has a first edge joined to an apex of the widened section and a second edge secured to the base assembly.

33. A carrier head, comprising:

a housing to be secured to a drive shaft;

a base assembly;

a loading chamber controlling the position of the base assembly relative to the housing; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface and a plurality of concentric annular flaps secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers;

wherein at least one of the annular flaps includes a widened section adjacent a juncture between the at least one annular flap and the main portion,

and wherein the widened section stiffens the annular flap allowing it to resist bowing when there is unequal pressure in adjacent pressurizable chambers.

34. The carrier head of claim 33, wherein the at least one annular flap includes a horizontal portion extending from the base assembly to the widened section.

35. A carrier head, comprising:

a base assembly; and

a flexible membrane having a generally circular main portion with a lower surface that provides a substrate-mounting surface, an outer annular portion extending from an edge of the

main portion and secured to the base assembly, and an inner annular portion extending from the main portion and secured to the base assembly, the volume between the base assembly and the flexible membrane forming a plurality of pressurizable chambers, the inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion,

wherein the widened section stiffens the inner annular portion allowing it to resist bowing when there is unequal pressure in adjacent pressurizable chambers.

36. The carrier head of claim 35, wherein the inner annular portion includes a horizontal portion extending from the base assembly to the widened section.

37. The carrier head of claim 35, wherein the inner annular portion includes a rim section between the base assembly and the widened section.

38. The carrier head of claim 37, wherein the widened section includes a sloped face on a side closer to the rim, and a generally vertical face on a side opposite the rim.

39. The carrier head of claim 38, wherein the rim section is connected to a top vertex of the widened section.

40. A flexible membrane for use in a chemical mechanical polishing carrier head, comprising:

a generally circular main portion with a lower surface to provide a substrate-mounting surface;

an outer annular portion extending from an edge of the main portion to be secured to a base assembly of the carrier head; and

an inner annular portion extending from the main portion and secured to the base assembly, the inner annular portion including a widened section adjacent a juncture between the inner annular portion and the main portion,

wherein the widened section stiffens the inner annular portion.

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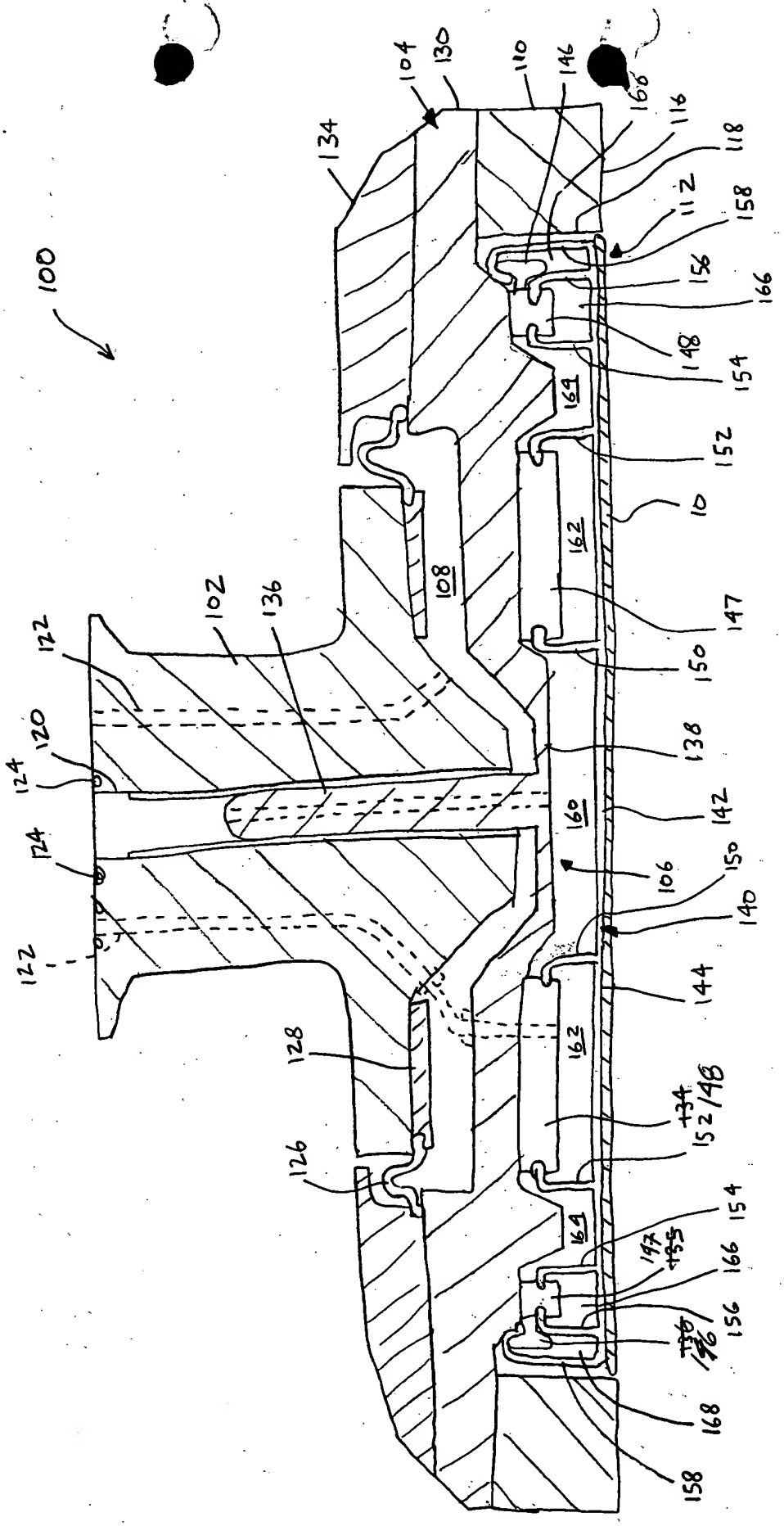

FIG. 1

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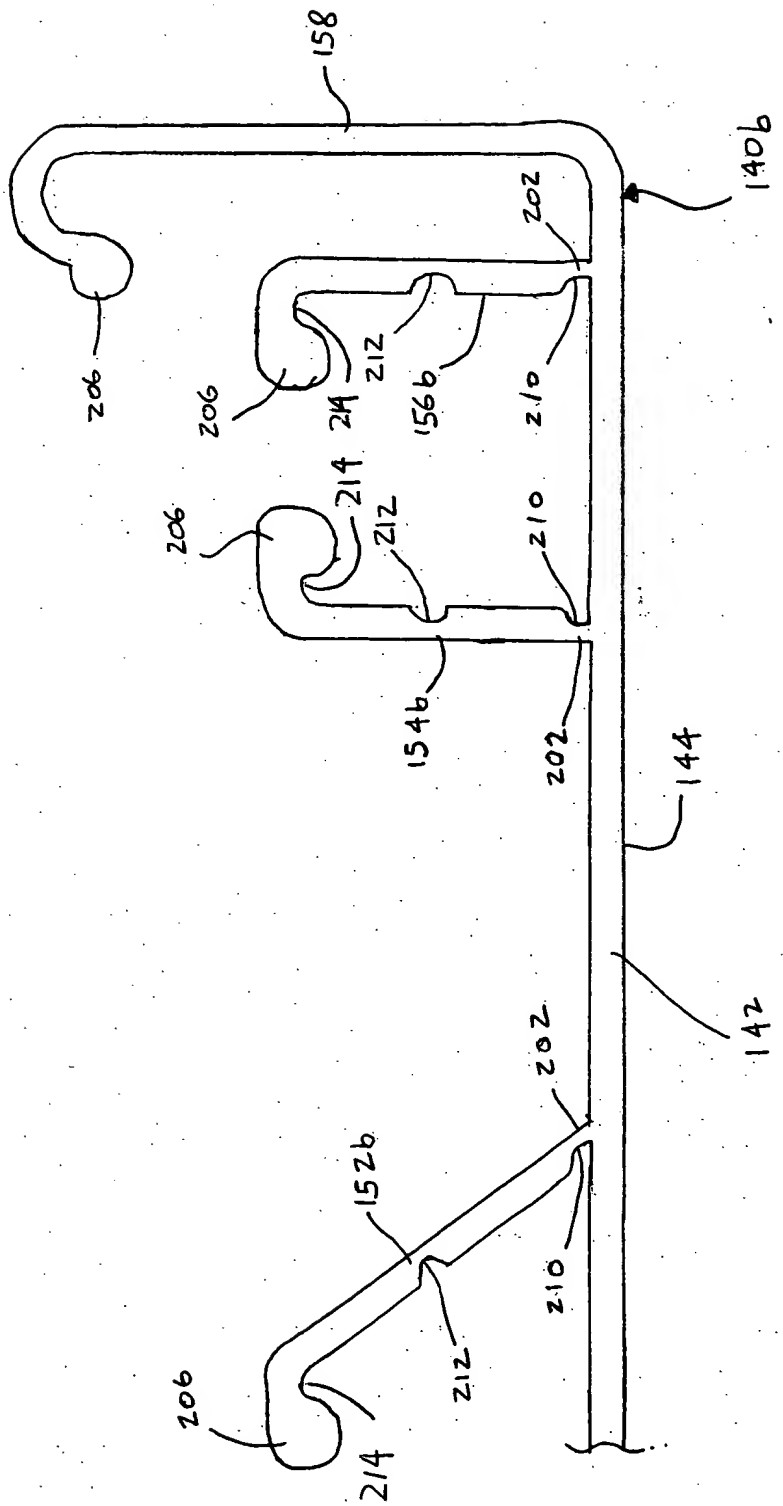

FIG 3